

# SSM3H137TU

## 1. Applications

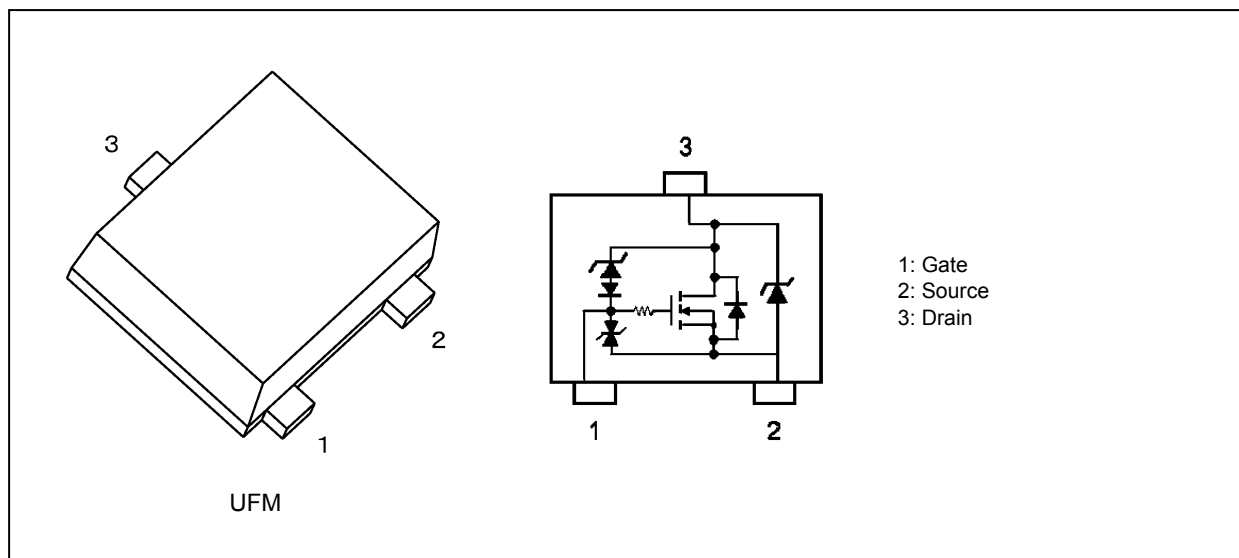
- Relay Drivers

## 2. Features

- (1) AEC-Q101 (Rev. D) qualified. (Note 1)
- (2) 4.0-V gate drive voltage.
- (3) Low drain-source on-resistance
  - :  $R_{DS(ON)} = 295 \text{ m}\Omega$  (max) (@ $V_{GS} = 4.0 \text{ V}$ ,  $I_D = 0.5 \text{ A}$ )
  - $R_{DS(ON)} = 280 \text{ m}\Omega$  (max) (@ $V_{GS} = 4.5 \text{ V}$ ,  $I_D = 1.0 \text{ A}$ )
  - $R_{DS(ON)} = 240 \text{ m}\Omega$  (max) (@ $V_{GS} = 10 \text{ V}$ ,  $I_D = 1.0 \text{ A}$ )

Note 1: For detail information, Please contact to our sales.

## 3. Packaging and Pin Assignment



Start of commercial production

2016-03

#### 4. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

| Characteristics                           | Symbol    | Rating     | Unit               |
|-------------------------------------------|-----------|------------|--------------------|
| Drain-source voltage                      | $V_{DSS}$ | 34         | V                  |
| Gate-source voltage                       | $V_{GSS}$ | $\pm 20$   |                    |
| Drain current (DC) (Note 1)               | $I_D$     | 2          | A                  |
| Drain current (pulsed) (Note 1), (Note 2) | $I_{DP}$  | 6          |                    |
| Power dissipation (Note 3)                | $P_D$     | 800        | mW                 |
| Power dissipation (t = 1 s) (Note 3)      |           | 1000       |                    |
| Channel temperature                       | $T_{ch}$  | 150        | $^{\circ}\text{C}$ |
| Single-pulse avalanche energy (Note 4)    | $E_{AS}$  | 3.5        | mJ                 |
| Avalanche current                         | $I_{AR}$  | 2.0        | A                  |
| Storage temperature                       | $T_{stg}$ | -55 to 150 | $^{\circ}\text{C}$ |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Ensure that the channel temperature does not exceed  $150\text{ }^{\circ}\text{C}$ .

Note 2: Pulse width (PW)  $\leq 10\text{ }\mu\text{s}$ , duty  $\leq 1\%$

Note 3: Device mounted on an FR4 board. (25.4 mm  $\times$  25.4 mm  $\times$  1.6 mm, Cu pad: 645 mm<sup>2</sup>)

Note 4:  $V_{DD} = 25\text{ V}$ , Starting  $T_{ch} = 25\text{ }^{\circ}\text{C}$ , L = 0.5 mH

Note: The MOSFETs in this device are sensitive to electrostatic discharge. When handling this device, the worktables, operators, soldering irons and other objects should be protected against anti-static discharge.

Note: The channel-to-ambient thermal resistance,  $R_{th(ch-a)}$ , and the drain power dissipation,  $P_D$ , vary according to the board material, board area, board thickness and pad area. When using this device, be sure to take heat dissipation fully into account.

## 5. Electrical Characteristics

### 5.1. Static Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

| Characteristics                      | Symbol        | Test Condition                                     | Min | Typ. | Max      | Unit             |
|--------------------------------------|---------------|----------------------------------------------------|-----|------|----------|------------------|
| Drain-source breakdown voltage       | $V_{(BR)DSS}$ | $I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$        | 34  | —    | 37       | V                |
| Drain cut-off current                | $I_{DSS}$     | $V_{DS} = 30.4\text{ V}$ , $V_{GS} = 0\text{ V}$   | —   | —    | 10       | $\mu\text{A}$    |
| Gate leakage current                 | $I_{GSS}$     | $V_{GS} = \pm 16\text{ V}$ , $V_{DS} = 0\text{ V}$ | —   | —    | $\pm 10$ |                  |
| Gate threshold voltage (Note 1)      | $V_{th}$      | $V_{DS} = 10\text{ V}$ , $I_D = 1\text{ mA}$       | 0.7 | —    | 1.7      | V                |
| Drain-source on-resistance (Note 2)  | $R_{DS(ON)}$  | $V_{GS} = 4.0\text{ V}$ , $I_D = 0.5\text{ A}$     | —   | 230  | 295      | $\text{m}\Omega$ |
|                                      |               | $V_{GS} = 4.5\text{ V}$ , $I_D = 1.0\text{ A}$     | —   | 220  | 280      |                  |
|                                      |               | $V_{GS} = 10\text{ V}$ , $I_D = 1.0\text{ A}$      | —   | 200  | 240      |                  |
| Forward transfer admittance (Note 2) | $ Y_{fs} $    | $V_{DS} = 10\text{ V}$ , $I_D = 0.5\text{ A}$      | —   | 2.2  | —        | S                |

Note 1: Let  $V_{th}$  be the voltage applied between gate and source that causes the drain current ( $I_D$ ) to be below (1 mA for this device). Then, for normal switching operation,  $V_{GS(ON)}$  must be higher than  $V_{th}$ , and  $V_{GS(OFF)}$  must be lower than  $V_{th}$ . This relationship can be expressed as:  $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$ .

Take this into consideration when using the device.

Note 2: Pulse measurement.

### 5.2. Dynamic Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

| Characteristics                | Symbol    | Test Condition                                                                                                                                                                                                   | Min | Typ. | Max | Unit        |
|--------------------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|-------------|
| Input capacitance              | $C_{iss}$ | $V_{DS} = 10\text{ V}$ , $V_{GS} = 0\text{ V}$ ,<br>$f = 1\text{ MHz}$                                                                                                                                           | —   | 119  | —   | $\text{pF}$ |
| Reverse transfer capacitance   | $C_{rss}$ |                                                                                                                                                                                                                  | —   | 8    | —   |             |
| Output capacitance             | $C_{oss}$ |                                                                                                                                                                                                                  | —   | 40   | —   |             |
| Switching time (turn-on time)  | $t_{on}$  | $V_{DD} = 20\text{ V}$ , $I_D = 0.5\text{ A}$ ,<br>$V_{GS} = 0$ to $4.5\text{ V}$ , $R_G = 10\text{ }\Omega$<br>Duty $\leq 1\%$ , $V_{IN}$ : $t_r$ , $t_f < 5\text{ ns}$ ,<br>Common source,<br>See Chapter 5.3. | —   | 320  | —   | ns          |
| Switching time (turn-off time) | $t_{off}$ |                                                                                                                                                                                                                  | —   | 800  | —   |             |

### 5.3. Switching Time Test Circuit

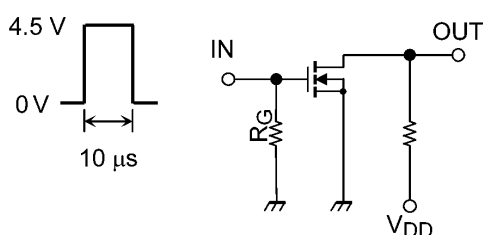


Fig. 5.3.1 Switching Time Test Circuit

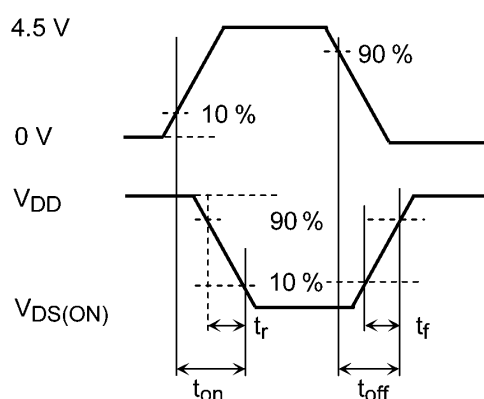


Fig. 5.3.2 Input Waveform/Output Waveform

### 5.4. Gate Charge Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

| Characteristics                                 | Symbol    | Test Condition                                                            | Min | Typ. | Max | Unit |
|-------------------------------------------------|-----------|---------------------------------------------------------------------------|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$     | $V_{DD} = 20\text{ V}$ , $I_D = 1.0\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ | —   | 3.0  | —   | nC   |
| Gate-source charge 1                            | $Q_{gs1}$ |                                                                           | —   | 0.8  | —   |      |
| Gate-drain charge                               | $Q_{gd}$  |                                                                           | —   | 0.4  | —   |      |

**5.5. Source-Drain Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^\circ\text{C}$ )**

| Characteristics                | Symbol    | Test Condition                                | Min | Typ.  | Max  | Unit |
|--------------------------------|-----------|-----------------------------------------------|-----|-------|------|------|
| Diode forward voltage (Note 1) | $V_{DSF}$ | $I_D = -2.0\text{ A}$ , $V_{GS} = 0\text{ V}$ | —   | -0.82 | -1.2 | V    |

Note 1: Pulse measurement.

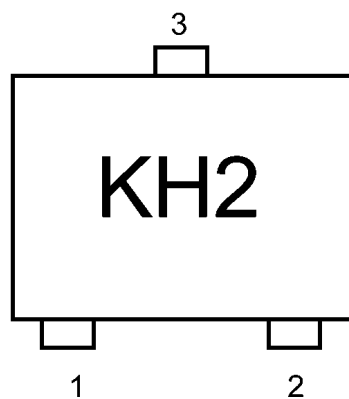
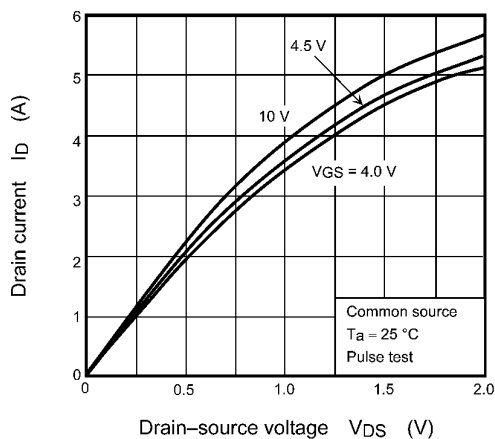
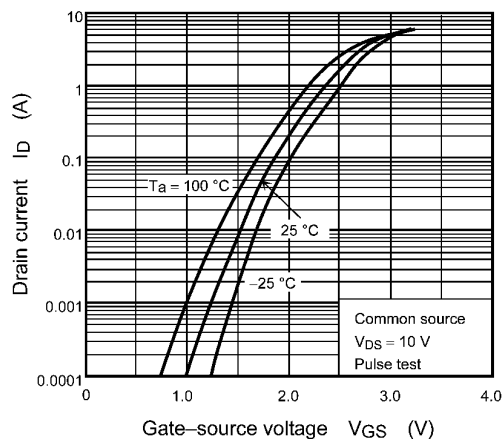
**6. Marking**

Fig. 6.1 Marking

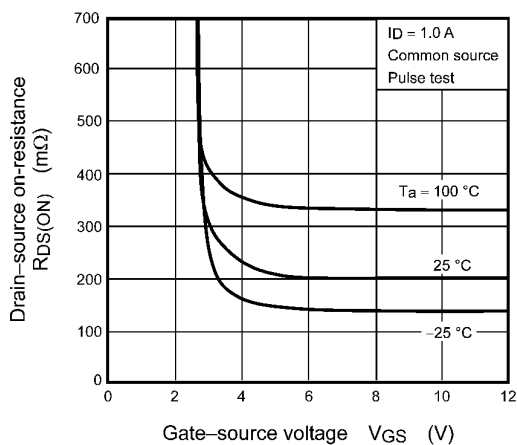
# 7. Characteristics Curves (Note)



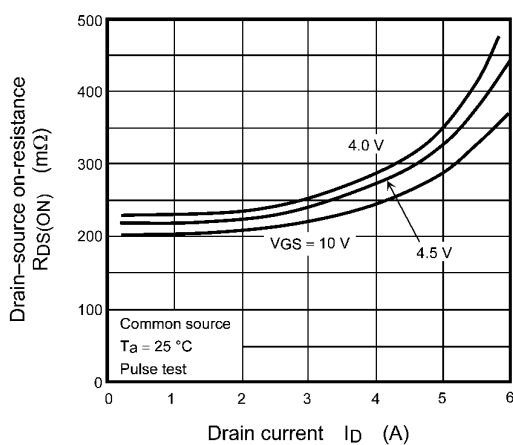
**Fig. 7.1  $I_D - V_{DS}$**



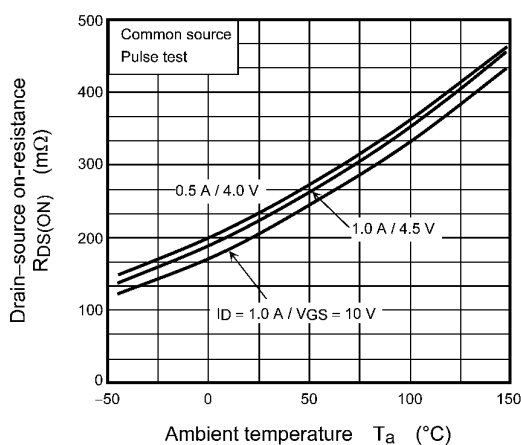
**Fig. 7.2  $I_D - V_{GS}$**



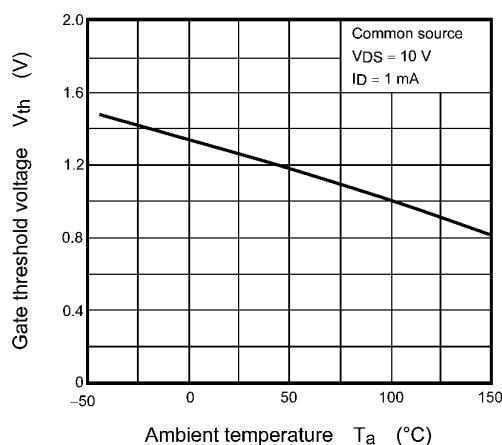
**Fig. 7.3  $R_{DS(ON)} - V_{GS}$**



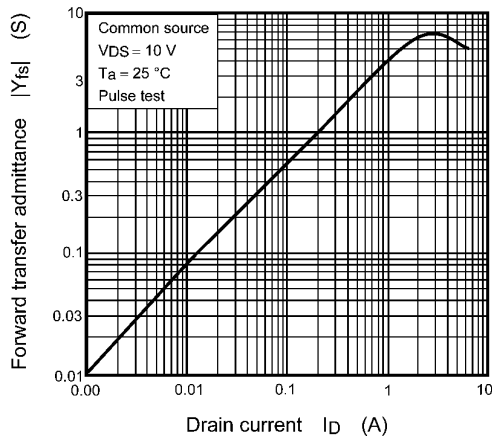
**Fig. 7.4  $R_{DS(ON)} - I_D$**



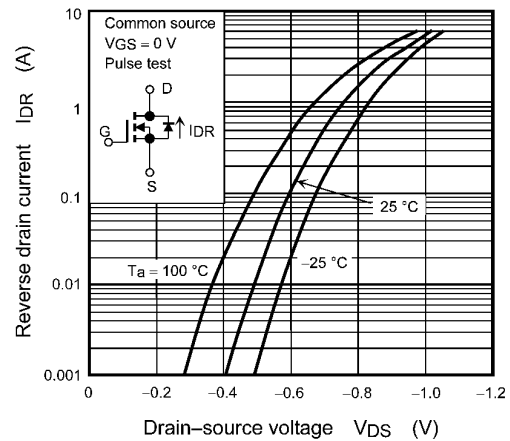
**Fig. 7.5  $R_{DS(ON)} - T_a$**



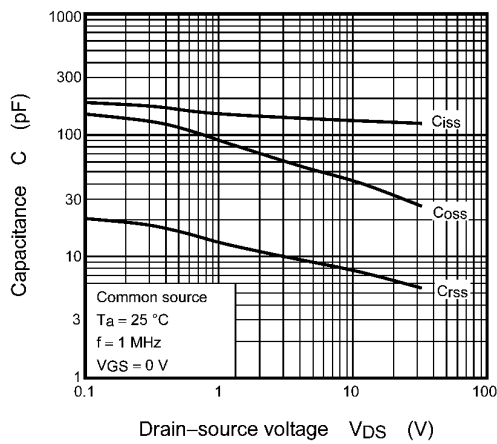
**Fig. 7.6  $V_{th} - T_a$**



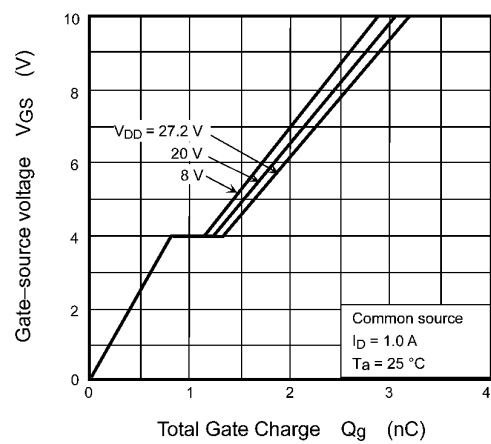
**Fig. 7.7**  $|Y_{fs}| - I_D$



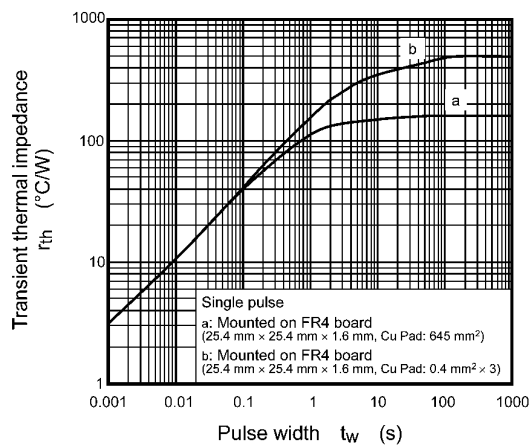
**Fig. 7.8**  $I_{DR} - V_{DS}$



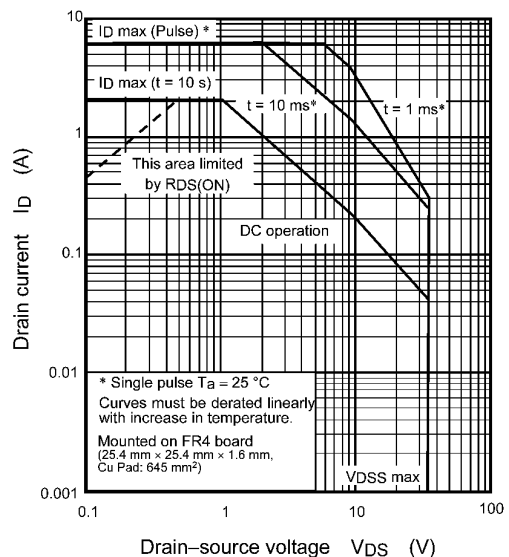
**Fig. 7.9**  $C - V_{DS}$



**Fig. 7.10** Dynamic Input Characteristics



**Fig. 7.11**  $r_{th} - t_w$  (MOSFET)



**Fig. 7.12** Safe Operating Area

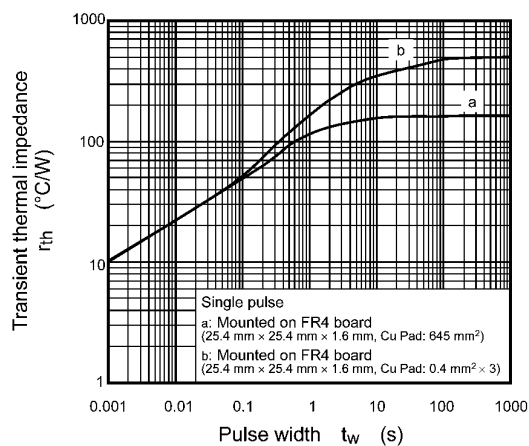


Fig. 7.13  $r_{th} - t_w$  (Zener)

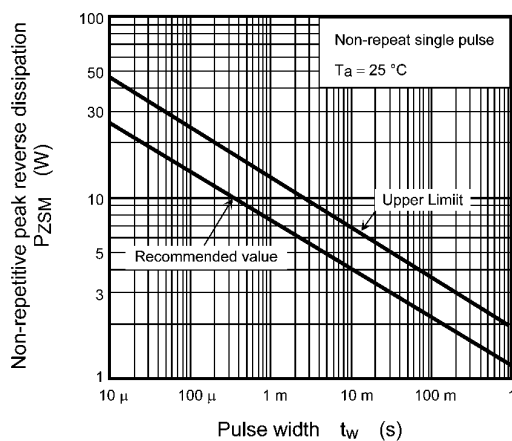
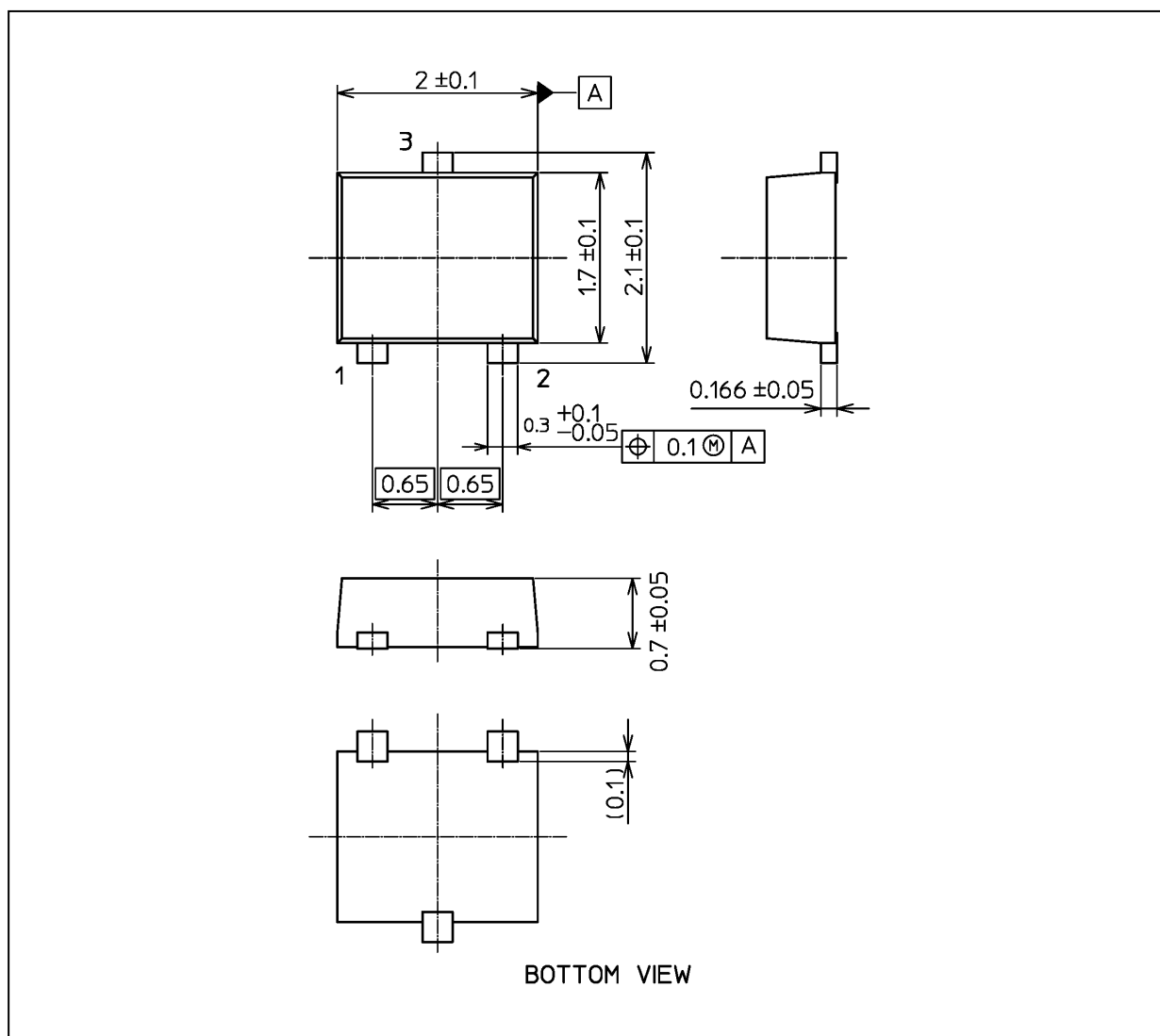


Fig. 7.14  $P_{ZSM} - t$

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

## Package Dimensions

Unit: mm



Weight: 6.6 mg (typ.)

| Package Name(s) |
|-----------------|
| Nickname: UFM   |

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